Investigation of fouling in plate heat exchanger at sugar factory

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Plate heat exchangers are efficient heat transfer equipment and now are widely used in industry. In comparison with shell-and-tube units they provide narrower temperature approach up to 1°C, less metal consumption and high energy saving potential. It makes this equipment more energy efficient and economically preferable. The process of flow movement in PHE is characterized by the highly developed turbulent flow caused by geometrical parameters of the criss-cross channels, formed by the adjacent plates [1]. This affects the hydraulic and thermal performance of the PHE unit. The mathematical simulation of fouling formation process will increase the reliability of this type of equipment and lead to its wider application in industry. In the present paper the dynamic of fouling formation inside the channels of plate heat exchanger is observed.

The fouling formation in heat transfer equipment is the complex process, which is determined by the physical properties of the heat carrier, material of the unit and hydraulic characteristics of the flow. The mathematical model based on the asymptotic behaviour [2] of water fouling is examined. The fouling process supposes the net rate of fouling accumulation as the difference between the fouling deposition rate and the fouling removal rate. The relation for forecasting the fouling resistance dynamics during the time is proposed.

The investigation of precipitation and particulate deposition in purified juice heating PHE for the first stage evaporation, which operates in sugar plant, was examined. In this position M15M plate heat exchanger produced by Alfa Laval is used. The analysis and mathematical simulation of the experimental data are presented. For the juice heaters the content of fouling deposition is mostly the calcium salts as calcium carbonates and sulphates. The parameters of the equation for deposition term estimation were determined for the regarded heat carrier. It allows to determine the deposition term and to simulate the fouling formation in time. The comparison of the experimental data and mathematical calculations showed a good agreement.

The proposed mathematical model enables to predict the fouling formation behaviour in plate purified juice heater and to determine the operation term for the cleaning of this unit. Basing on the observed model, the software, which enables to determine the periods of PHE cleaning during the operation was developed. The comparison of the industrial measurement data with calculation results is presented.

Key words: plate heat exchanger, thin juice heater, precipitation fouling, heat transfer.

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